



Institute of Automation and Information Technologies department
"Automation and control"

EDUCATIONAL PROGRAM
7M07114 - AUTOMATION AND ROBOTIZATION
code and name of the educational program

Code and classification of the field of education: 7M07 Engineering,
manufacturing and construction industries

Code and classification of areas of study: 7M071 Engineering and
Engineering

Group of educational programs: M100 Automation and control

NQF level: 7

ORC level: 7

Study period: 1.5 years

Volume of loans:**90 credits**

Almaty 2022

The educational program "**7M07114 - Automation and robotization**" was approved at a meeting of the Academic Council of KazNRTU named after K.I.Satpayev.

Protocol №13 dated April 28, 2022

Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after K.I. Satpayev.

Protocol № 7 dated April 26, 2022

The educational program "**7M07114 - Automation and robotization**" was developed by the academic committee in the direction "**7M071 - Engineering**".

FULL NAME	Scientific degree / scientific title	Job title	Workplace	signature
Chairman of the Scientific Committee:				
Aldiyarov Nakhypbek Ualievich	Candidate of Physics and Mathematics Sciences	Head of the "Automation and Management" department	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77772746301	
Teaching staff				
Suleymenov Batyrbek Aitbaevich	Doctor of technical sciences	Professor	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77017013722	
Beysembaev Akambay Agibaevich	Candidate of technical sciences, associate professor	Associate Professor	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77783337261	
Sarsenbayev Nurlan Saduakasovich	Candidate of technical sciences	Associate Professor	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77055716781	
Shiryaeva Olga Ivanovna	Candidate of technical sciences	Associate Professor	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77776470154	

Kulakova Elena Aleksandrovna	PhD	Senior teacher	KJSC "Kazakh National Technical Research University named after K.I. Satbaev", mobile phone: +77771853069	
Employers:				
Abdigaliyev Serik Kanaevich		Chief	"HONEYWELL - AUTOMATIC CONTROL SYSTEM LLP"	
Zikirbai Kuanysh Yergarauly	PhD	Head of the Department of Innovations and Information Technologies	"Saiman Corporation LLP", mobile phone: +77716005070	
Students:				
Sultanbayeva Guzal Bahadirkazy		1st year master student	NJSC "Kazakh National Research Technical University named after K.I.Satpayev", mobile phone: 87056883355	

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List of abbreviations and symbols

OP	Educational program
LSG	Microprocessor control systems
RFP	Application package

1. Description of the educational program

The educational program (hereinafter EP) is a set of documents developed by the Kazakh National Research Technical University named after K.I. Satpayev and approved by the Ministry of Education and Science of the Republic of Kazakhstan.

Educational program 7M07114 - Automation and robotics involves the training of highly qualified specialists in the field of automation, robotics, artificial intelligence and automated control.

The bachelor's degree in the EP "Automation and Robotization" provides for the acquisition of competencies in a wider area: automation, robotics, artificial intelligence and automated control in order to ensure the adaptation of bachelor's graduates to the requirements of the labor market. This EP of the master's program provides for further deepening of the competencies acquired in the bachelor's degree. In this connection, modern innovative disciplines have been introduced into the program for each of the trajectories.

In the process of mastering the educational program, the Master of Technical Sciences in the field of automation of production processes must acquire the following key competencies:

- will be able to analyze literature data and, on the basis of the analysis, determine and experimentally implement possible ways to modernize automated and robotic systems using new technical solutions.
- will be able to apply appropriate methods of analysis, both qualitative and quantitative, to collect and integrate information in the best possible way.
- will be able to conduct independent original research that contributes to the development of science, in accordance with the best practices and industry standards.
- have the skills to create robotic systems and automated technological complexes.
- have professional knowledge in the field of automation, robotization, artificial intelligence and automated control.

Objects of professional activity:

- automation and process control systems;
- robotic systems and complexes;

The Master in Automation of Production Processes must solve the following tasks in accordance with the types of professional activity:

in the field of production and technological activities:

- to be a leading engineer, a leading specialist of the production unit for the operation, maintenance, repair and adjustment of technical means of automated control systems for production processes in various industries;

in the field of organizational and managerial activities:

- to be the head of the department for the maintenance and repair of elements, devices of automated control systems for production processes in various industries;

in the field of experimental research activities:

- to be a leading specialist in conducting experimental studies of industrial automation objects;

in the field of research and teaching activities:

- be a researcher in a scientific laboratory for the research and development of modern automated control systems for production processes in various industries;

in the field of design activities:

- be a leading engineer or chief engineer of a project for the development and design of automated control systems for production processes in various industries.

2. CPurpose and objectives of the educational program

Purpose of the OP: The purpose of the educational program is to train undergraduates in basic and specialized disciplines with the achievement of relevant competencies.

Tasks of the OP:

Based on the achievements of modern science, technology and production, to provide knowledge and skills in the field of:

- automation;
- robotics;
- artificial intelligence;
- automated control.

3. Requirements for evaluating the learning outcomes of an educational program

OP 7MO7114 - "Automation and robotization" ensures that all students achieve the learning outcomes necessary for professional activities. At the end of the program, the student must:

- to freely use the state, Russian and one of the common, foreign languages in professional activities.

- master the basic methods: data mining, descriptive analysis, correlation and regression analysis, classical calculus of variations, matrix description of spatial mechanisms.

- master the basic methods of modern control theory: synthesis of systems with given dynamics using standard and relay controllers, digital control systems, systems with a variable structure, modal control, identification and adaptation of optimal control.

- be fluent in the basics of philosophical, pedagogical, economic knowledge.

- have the skills to describe the kinematics and dynamics of industrial robots, methods for developing software trajectories, developing adaptive and non-adaptive control algorithms for industrial robots.

- have the skills to create automated process control systems and robotic technological complexes.

- know modern technical means of automation and robotics. Own the basics of the practical application of modern technical means of automation.
- have the skills to build microprocessor systems (MCS). To be able to design hardware and software of LSU.
- master the skills of programmatic and stabilizing, optimal and adaptive control and synthesis of intelligent control systems.
- possess the skills of conducting research and design work on the development of automated process control systems and robotic technological complexes in various industries.

4. Passport of the educational program

4.1.General information

No.	Field name	Note
1	Code and classification of the field of education	7M07 Engineering, manufacturing and construction industries
2	Code and classification of areas of study	7M071 Engineering and Engineering
3	Group of educational programs	M100 Automation and control
4	Name of the educational program	7M07114 - Automation and robotization
5	Brief description of the educational program	Educational program 7M07114 - Automation and robotics involves the training of highly qualified specialists in the field of automation, robotics, artificial intelligence and automated control.
6	Purpose of the OP	The purpose of the educational program is to train undergraduates in basic and specialized disciplines with the achievement of relevant competencies.
7	OP type	New OP
8	NQF level	7
9	ORC level	7
10	Distinctive features of the OP	Not
11	List of competencies of the educational program:	In the process of mastering the educational program, the Master of Technical Sciences in the field of automation of production processes must acquire the following key competencies: <ul style="list-style-type: none"> - will be able to analyze literature data and, on the basis of the analysis, determine and experimentally implement possible ways to modernize automated and robotic systems using new technical solutions. - will be able to apply appropriate methods of analysis, both qualitative and quantitative, to collect and integrate information in the best possible way. - will be able to conduct independent original research that contributes to the development of science, in accordance with the best practices and industry standards.

		<ul style="list-style-type: none"> - have the skills to create robotic systems and automated technological complexes. - have professional knowledge in the field of automation, robotization, artificial intelligence and automated control.
12	Learning outcomes of the educational program:	<p>PO1 Cfreely use the state, Russian and one of the most common, foreign languages in professional activities.</p> <p>PO2 Bmaster the basic methods: data mining, descriptive analysis, correlation and regression analysis, classical calculus of variations, matrix description of spatial mechanisms.</p> <p>PO3 Bmaster the basic methods of modern control theory: synthesis of systems with given dynamics using standard and relay controllers, digital control systems, systems with a variable structure, modal control, identification and adaptation of optimal control.</p> <p>PO4 Cfreely own the basics of philosophical, pedagogical, economic knowledge.</p> <p>PO5 Bto master the skills of describing the kinematics and dynamics of industrial robots, methods for developing software trajectories, developing adaptive and non-adaptive control algorithms for industrial robots.</p> <p>PO6 Bto master the skills of creating automated process control systems and robotic technological complexes.</p> <p>PO7 Wnaty modern technical means of automation and robotics. Own the basics of the practical application of modern technical means of automation.</p> <p>PO8 Vto master the skills of building microprocessor systems (MCS). To be able to design hardware and software of LSU.</p> <p>PO9 Bto master the skills of programmatic and stabilizing, optimal and adaptive control and synthesis of intelligent control systems.</p> <p>PO10 Vhave the skills to conduct research and design work on the development of automated process control systems and robotic technological complexes in various industries.</p>
13	Form of study	full-time
14	Training period	1.5 years
15	Volume of loans	90 credits
16	Languages of instruction	Kazakh, Russian
17	Awarded Academic Degree	Master of Engineering
18	Developer(s) and authors:	Aldiyarov N.U., Zhanabaeva E.Zh.

4.2. The relationship between the achievability of the formed learning outcomes in the educational program and academic disciplines

No.	Name of the discipline	Brief description of the discipline	Number of credits	Formed learning outcomes (codes)									
				PO1	PO2	PO3	PO4	RO5	RO6	RO7	RO8	RO9	RO10
Cycle of basic disciplines University component													
1	Foreign language (professional)	A course focusing on setting up conversational vocabulary and grammar to improve communication in the field of project management and improve reading, reading, listening and grammar skills at the "Intermediate" level. Students are expected to acquire their Business English vocabulary and learn the grammatical structures that are often used at a professional level. The course is composed of 6 modules.	2	V									
2	Psychology of management	The discipline "Psychology of management" deals with the problems of making managerial decisions in the context of the practical work of the organization. The relationship between the manager and the staff, ways of their productive cooperation, methods for resolving conflict situations are analyzed, special attention is paid to group dynamics, negotiation processes and decision-making technologies. Management psychology as a science relies on various psychological methods, the main of which are observation and experiment.	2				V						
3	Management	The course provides an overview of business and management in the field of theoretical developments and practical activities. It includes consideration of classical management theories and modern approaches to organizations and business. the main building blocks are the management functions, linking management processes and interactions between meetings and external meetings. Particular attention is paid to social life and business ethics, and also includes elements of project management.	2										V
Cycle of basic disciplines Optional component													
4	Modern management theory	The content of the discipline includes the study of modern approaches to the analysis and synthesis of automatic control systems based on the methodology of the "state space". The properties of linear and nonlinear systems and methods of their study are considered from the unified positions of the state space method. Basic information about systems with variable structure, modal control, identification, adaptation and optimization in control systems is given.	four				V						

5	Integrated automation and control technologies	The task of studying the discipline is to acquire knowledge on effective technologies for modeling automation objects, study directions for the development of automation tools, fundamentally new methods of process control, computer-integrated production of a new generation, as well as the acquisition of skills in the formation of a production automation strategy, the use of modern automation devices to solve control problems , the formation of sets of modern sensors and transducers to combine them into a system of computer-integrated production.	four						v		v	
6	Data Mining Methods	The discipline considers the most common methods and algorithms of data mining. Particular attention is paid to understanding the principles and concepts underlying modern intellectual methods. On practical examples, the features of data analysis during research in the field of automation and control are considered.	5		v							
7	Intelligent technologies in robotics	The course "Intelligent Technologies in Robotics" discusses the main characteristics of robots: load capacity, coordinate movement system, number of degrees of freedom; speed of movement and the magnitude of the stroke of each link, positioning error, method of installation at the workplace, working area of service. Classification and principles of construction of robotic systems. Technological requirements for robotic systems used in enterprises. An actively developing field of artificial intelligence. Includes models, methods and algorithms focused on automatic accumulation and formation of knowledge based on data analysis and generalization. Includes learning by example (or inductive) as well as traditional approaches from the theory of pattern recognition.	5				v	v		v		

Cycle of major disciplines
University component

8	Automation of technical systems	The content of the discipline includes the characterization of qualitative and quantitative indicators of the reliability of control system elements, their probabilistic and statistical assessment based on test results, the study of the main methods for calculating the reliability of recoverable and non-recoverable systems, analysis of the need and selection of the redundancy ratio. Training of specialists for independent solution of theoretical and applied problems related to the assessment, analysis and ensuring the reliability of control systems and their elements.	5						v		v	
9	Internship	In order to consolidate and deepen the theoretical knowledge gained by students in the learning process, the acquisition of practical skills, competencies and professional experience in the educational program being taught, as well as the development of best practices, an internship is carried out. Students have practical training at enterprises, working directly at the workplaces of students, performing specific production tasks, consolidating theoretical knowledge. In the process of practice, practice leaders and	four	v								

		appointed specialists at the workplace provide students with the necessary assistance and monitor (control) the process of internship in terms of meeting deadlines and content. The student keeps personal records of the practice in the practice diary.										
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Cycle of major disciplines
Selectable Component

10	Diagnostics of elements of automation systems	The content of the discipline includes the characteristics of qualitative and quantitative indicators of the reliability of technical systems, their probabilistic and statistical evaluation based on test results, the study of the main methods for calculating the reliability of recoverable and non-recoverable systems, the analysis of the need and the choice of the redundancy rate, consideration of methods and models of technical diagnostics of automation systems. Training of specialists for independent solution of theoretical and applied problems related to the assessment, analysis, diagnostics and ensuring the reliability of systems.	5									v
11	Reliability of the control system and its elements	In the discipline "Reliability of the control system and its elements", the main terms, definitions and definitions in reliability calculations, quantitative indicators of the reliability of calculated and unacceptable technical systems, basic calculations of the reliability of complex systems, types of tests for reliability, issues of backup selection and determination of the reliability of backup systems are considered. To consolidate theoretical materials, standard tasks are used. As well as issues of reliability of security and control systems.	5									v
12	Design of automation systems	In the disciplines of research, the stages of designing process control systems. Methods for preparing project documentation in accordance with subsequent standards; methods for constructing mathematical models, analysis and synthesis systems using modern computer technologies and medical research; development of science and technology and their impact on automation; The essence of the system approach in the design of modern hardware and software computing.	5									v
13	Distributed control systems	The content of the disciplines "Distributed control systems" includes the study of mathematical methods of description, stability research, evaluation of the quality of the distributed systems control process. The issues of choosing structures and compositions and software tools for distributed control systems are considered. Methods and algorithms for building distributed control systems in various industrial production systems, methods for mathematical description, stability studies and quality assessment of control system distribution processes.	5			v						v
14	Project management	After the successful completion of the discipline, undergraduates gain knowledge about the challenges of project management with an emphasis on modern behavioral models of project-oriented business development	5									v

		management. The course program was created on the basis of international standards recognized by the business community PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management. The features of organizational management are studied. Systemic practices, methods and procedures are considered, consideration in the innovative activity of bodies with the psychological aspects of team building, communication and interaction with stakeholders.									
15	New information technologies	The course "New Information Technologies" explores the fundamental problems and mathematical methods of systems theory, the characteristics of the analysis of system analysis, the procedures for system analysis, the collection of data on the functioning of the system, the study of information flows, the construction of models of systems, the verification of the adequacy of models, the analysis of uncertainty and sensitivity, the study of resource opportunities, defining the goals of system analysis, changing options, generating alternatives, implementing choices and decisions; Models of complex systems; Classification of types of modeling of complex systems, calculations and approaches to the construction of mathematical models, stages of building a mathematical model, methods for qualitative evaluation of systems, methods for calculating the evaluation of systems, decision-making in conditions of conflict, risks, uncertainty.	5						V		
16	Modern actuators of automation systems	In the content of the course, general issues of the theory of actuators of automation were considered, a decision was made to arrest actuators and their main characteristics, as well as issues related to actuators as an element of an automation system. The main goal of training is to teach the ability to choose the correct setting devices in automation systems, explaining that setting devices appear in automation systems.	5						V		
17	Microprocessor control systems for technological processes	In this discipline, emphasis is placed on the features of using the nomenclature of program-logical control of production, used in the technical means of protecting the company. It provides for the study of the use of groups and various classes of microprocessor systems, the acquisition of skills in the development of embedded systems. A certain place is given to the design of hardware and software of microprocessor systems on a systemic, structural and logical basis.	5						V	V	
18	Robot Numerical Control Systems	The content of the disciplines "Systems of numerical control of robots" includes the study of mathematical methods of program control of robots, the basics of developing algorithms and robot control cyclograms. The structure, composition of the purpose of elements of cyclic, positional and contour systems of program control of robots, systems of numerical program control of machine tools, machines are considered.	5		V				V		
19	Optimal control systems (with AI elements)	The content of the discipline "Individual control systems" includes the study of mathematical methods of individual control based on the classical calculus	5							V	

		of variations, the basics of maximum detection and the dynamic programming method. Models and methods of programmatic and stabilizing universal control are considered. Separate considerations of methods for the synthesis of intelligent systems of various control. Training of highly qualified personnel who know the basics of research and building optimal control systems based on the methods of classical calculus of variations.										
20	Vision systems (with AI elements)	The disciplines "Technical theory systems" study the main types of technical theory systems used in real-time control, features of hardware and software of technical theory, organization and conduct of experimental research in the field of technical theory systems. Methods of processing and transformation of metals are being studied.	5						v			
21	Digital control systems	The content of the disciplines "Digital Control Systems" includes the study of the mathematical apparatus for describing digital systems, describing digital systems in time and frequency form, and synthesizing digital controllers when transferring production processes. Obtaining knowledge about the advantages of building the features of the use of digital control systems, the conditions for the feasibility and performance of digital control systems and their application in technological processes in industry.	5		v					v		
22	Robot Control Dynamics	The content of the discipline "Dynamics of Robot Control" includes the study of mathematical approaches to cyclic, positional and contour control of industrial robots, models and algorithms for the kinematic and dynamic analysis of industrial robots, the study of the kinematics and dynamics of the manipulator and the drive system of an industrial robot.	5					v				
23	Automation of control system design	The content of the discipline "Automation of the design of control systems" includes the study of methods of analysis and synthesis of control systems, the choice of structure and the calculation of the parameters of the control law. The procedures for the analytical design of regulators, the development of structural, functional and other automation schemes using modern application software packages (APP) are considered. Mastering methods and algorithms for constructing mathematical models of objects and calculating modern automatic control systems.	5									v
24	Automated design of robotic systems	The course "Automated design of robotic systems" considers the training of specialists who own the theoretical foundations of designing control systems and methods for performing experimental and computational work on the creation and operation of automation systems based on modern software and hardware.	5									v

5. Curriculum of the educational program



SATBAYEV
UNIVERSITY

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATpayev

CURRICULUM

of Educational Program on enrollment for 2022-2023 academic year
Educational program 7M07114 - "Automation and robotization"
Group of educational programs M100 - "Automation and control"

Cycle code	Cycles of disciplines	Number of credits for the entire period of study			Total
		university component (UC)	component of choice (CCB)	Credits	
BD	Cycle of basic disciplines	6	9	15	
PD	Cycle of profile disciplines	10	35	45	
	Total for theoretical training:	16	44	60	
	ERWM				18
FA	Final attestation	12			12
	TOTAL:	12	16	44	90

Decisions of the Academic Council of Kazatu named after K.Satpayev, Protocol № 8 of "27-04-2013".

DECISION OF THE ALBANIAN COURTS OF APPEAL UNDER THE PRESIDENCY OF THE
PROSECUTOR'S OFFICE AND THE HIGH PROFESSIONAL COUNCIL OF ATTORNEYS NAMED AFTER K. SATMAYRE, PROTOCOL NO 7-26/04. 2022.

Decision of the Educational and Methodological Chamber of Kazakh State University, No. 177, dated May 10, 2022.

3220 Boston for Academic Affairs

B.A. Zhantikov

RESULTS: EDUCATION OF STAFF

R.K. Uskewharyan

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S. U. ALDINSKRON

**Representative of the Council from
countries**

S.K. Abdulla et al.

5.1. Elective disciplines of the educational program



ELECTIVE DISCIPLINES of the educational program for recruitment for the 2022-2023 academic year
Educational program 7M07114 - "Automation and robotization"
Group of educational programs M100 - "Automation and control"

Form of study: full-time		Duration of study: 1,5 year	Academic degree: Master of Technical Sciences			
Elective code according to the curriculum	Discipline code	Name of disciplines	Semester	Cycle	Credits	Iek/lab/prizes
Module of theoretical foundations of management						
1201	AUT711	Modern control theory	I	B	4	2/0/1/3
	AUT712	Integrated automation technology and management		B		2/0/1/3
1202	AUT266	Data Mining Methods	I	B	5	2/0/1/3
	AUT267	Intelligent technology in robotics		B		2/0/1/3
1302	AUT299	Diagnostics of system automation	2	P	5	2/0/1/3
	AUT700	The reliability of the management system and its elements		P		2/0/1/3
1307	AUT225	Automation systems design	2	P	5	2/0/1/3
	AUT707	Distributed Control Systems		P		2/0/1/3
	MNG705	Project Management		P		2/0/1
Control system design module						
1301	AUT709	New information technologies	I	P	5	2/0/1/3
	AUT285	Modern executive devices of automation systems		P		1/1/1/3
1303	AUT271	Microprocessor control systems of technological processes	I	P	5	1/1/1/3
	AUT272	Systems for numerical programmable control of robots		P		1/1/1/3
1304	AUT705	Optimal control systems	2	P	5	2/0/1/3
	AUT706	Technical Vision system		P		2/0/1/3
1305	AUT237	Digital control systems	2	P	5	1/1/1/3
	AUT251	Dynamics of robot control		P		1/1/1/3
1306	AUT701	Automation of control systems design	2	P	5	2/0/1/3
	AUT702	Automated projection of robotic systems		P		2/0/1/3
The number of credits in elective subjects for the entire period of study						
			Cycles of disciplines	Credits		
			Cycle of basic disciplines (B)	9		
			Cycle of profile disciplines (P)	35		
			TOTAL:	44		

Decision of the Academic Council of the Institute Аддайров, Protocol № 6 от 22.04.2022г.

Head of the Department "Automation and Control"

N.U. Aldiyarov

Representative of the Council from employers

S.K. Abdigaliyev

6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of development additional educational programs (Minor)